UNCLASSIFIED

DTIC FILE COPY (2)

AD-A187 942

REPORT DOCUMENTATION PAGE

	1b. RESTRICTIVE MARKINGS
AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S) AFOSR-TR- 87-1831
6a. NAME OF PERFORMING ORGANIZATION The Smith-Kettlewell Eye Research Foundation — 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION Air Force Office of Scientific Research/NL
6c. ADDRESS (City, State, and ZIP Code) 2232 Webster Street San Francisco, CA 94115	7b. ADDRESS (City, State, and ZIP Code) Bldg. 410 Bolling AFB, D.C. 20332
8a. NAME OF FUNDING/SPONSORING ORGANIZATION AFOSR — 8b. OFFICE SYMBOL (If applicable) NL	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER AFOSR-83-0320
8c. ADDRESS (City, State, and ZIP Code) Bldg. 410 Bolling AFB, D.C. 20332	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 61102F — PROJECT NO. 2313 — TASK NO. A5 — WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)

VISUAL EVOKED POTENTIALS (U)

12. PERSONAL AUTHOR(S) Nakayama, K.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Annual Tech. Report	FROM 9/1/86 TO 8/31/87	~~November 3~~, 1987	4

16. SUPPLEMENTARY NOTATION

DTIC ELECTE JAN 11 1988

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Progress over the past year has been rapid and wide ranging, covering two primary areas. First, in th area of visual attention, we have shown both the existence of a sustained and a transient component of enhanced pattern recognition. This cannot be explained by visual transients or eye movements. Second, we have examined a wide range of issues related to partial visibility (occlusion) using stereoscopic displays. In particular, we have shown that pattern recognition of partially hidden objects is superior if the pattern is in a rear vs. front stereoscopic plane, that the solution to the aperture problem for motion is dictated by whether line terminators are seen as real terminators or the result of occlusion by other surfaces, and finally, we have shown that the depth interpretation of untextured stereograms requires that the visual system classify edges before evaluating their depth.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL JOHN F. TANGNEY	22b. TELEPHONE (Include Area Code) (202) 767-5021 — 22c. OFFICE SYMBOL NL

DD FORM 1473, 84 MAR — 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

87 12 29 099

NOV 1987

Ken Nakayama, Ph.D.
AFOSR-83-0320

AFOSR-TR- 87-1831

ANNUAL TECHNICAL REPORT (Sept. 1, 1986 - August 31, 1987)

Research Objectives:

We have had two major research objectives over the past year. Our first goal was to continue our studies on directed visual attention, asking how narrowly attention can be focussed and to explore its possible relation to saccadic eye movements. Our second goal represented a new direction in the research effort, asking how the visual system deals with the problem of occlusion.

Status of Research.

An unusually large number of new observations have been made in the past year. Some of these are summarized below:

Visual attention:

1. Using vernier acuity targets in a cued attention paradigm, we found that performance could go from essentially chance to nearly perfect depending on the timing of a pre-cue. This confirms previous work (see technical report of last year) and shows that high resolution tasks such as vernier acuity require much in the way of concentrated focal attention.

2. We found that the focal attentional window could be made wider but at the expense of less enhanced performance. We also investigated whether the size of the attentional window might be related to the level of resolution required by the task. So far and to our surprise, the size of the target did not shrink down the attentional window. This is a puzzling result (it does not support the general theory that we have proposed - Nakayama, K., The iconic bottleneck and the tenuous link between early vision and perception, in press) and will be investigated more extensively.

3. Focal attention and Express saccades. Saccades having latencies much shorter than normal saccades have been described by Burkart Fischer (University of Freiburg, FRG). Fischer's interpretation is that saccades usually have a long latency because the observer first must release attention from the current fixated site and then direct attention to the new site before making the saccade. The paradigm to set up the express saccade removes the first step, the release of attention, by turning off the fixation for 200 milliseconds before presenting the target. Fischer's interpretation of the experiment is that this "removal" disengages attention from the fixation and thus shortens the time for attention to reach the new locus, thereby shortening the saccadic latency. In extensive studies of one subject, employing the same technique of fixational removal used to generate express saccades, we found that we

could find an analogous "express" attentional shift to peripheral points. Thus the rise time of "attention" was greatly enhanced for the same conditions that ordinarily generate express saccades. This provides new and independent support for Fischer's hypothesis.

Studies on occlusion

The basic aim of this research was to investigate how the visual system deals with the problem of partial visibility, a situation usually occasioned when one object occludes another. Motivating most of our research are two core insights. First is the understanding that the boundaries of surfaces (edges) as well as the ends of lines (terminators) could either reflect the properties of the object itself (i.e. are intrinsic) or they could be accidental, the result of being occluded by other objects (extrinsic). If they are intrinsic, then such edges or terminators tell us something about the surface or the line. If not, however, they are spurious and should be ignored by later processing. Our second core insight is that if there is a border in common between two surfaces, the border always "belongs" to the front surface. Thus depth is a computationally plausible basis on which to make the extrinsic vs intrinsic classification of edges.

Consistent with the theoretical position described above we have made the following new observations:

1. pattern recognition of partially visible objects (faces) is superior when the pattern is in the rear stereoscopic plane.
2. The solution to the aperture problem for motion depends critically as to whether the ends of the line are considered as real terminators (i.e. intrinsic to the line) or as simply virtual terminators, defined by occlusion. In this regard, the Wallach Barber Pole phenomenomon no longer obtains if the moving lines are perceived as behind the aperture defined by stereoscopic disparity.
3. Filled stereo-grams (where the targets are solid areas rather than lines or dots) behave completely differently than expected from the canons of classical stereopsis. Rear planes in particular can be seen as essentially flat when classical stereopsis would indicate that they should be tilted. This follows from the fact that the border in common between two planes should be classified as "extrinsic" to the rear plane and intrinsic to the front plane. As a consequence "extrinsic" edges have no input to stereopsis and the tilt in the rear plane cannot be seen.
4. Unpaired monocular areas will be rivalrous and seen in front if they are not consistent with real-world geometrical constraints of occlusion.
5. Unpaired monocular points will generate subjective contours such that a vertical contour will appear to the right of an unpaired point presented to the left eye and will appear to the left of an unpaired point presented to the right eye.
6. In relation to a binocularly fused target, adjacent unpaired monocular points presented to the right eye will be seen in back if they located to the right and in front if they are presented to the left. Conversely, points presented to the left eye only will be see in back if they are located to the left and in front if they are presented to the right.
7. Neon color spreading is critically related to depth. Spreading will

occur for very specific depth relations and will spread only to the borders of subjective contours.

Manuscripts, published and planned:

Over the past year we have made a large number of observations. Of high priority is to complete the experiments and then to write them up. The following manuscript titles are envisioned.

1. The role of stereoscopic disparity in the pattern recognition of partially visible objects. (Nakayama, Shimojo and Silverman - nearly completed).

2. Sustained and transient aspects of focal visual attention. (Nakayama, Mackeben and Silverman)

3. Express attentional shifts, an analogy to express saccades (Nakayama, Mackeben and Silverman)

4. The iconic bottleneck and the tenuous link between early visual processing and perception (Nakayama - essentially completed).

5. Role of stereoscopic depth in the solution to the aperture problem (Shimojo, Silverman and Nakayama)

6. Seeing a moving bar behind a slit (Shimojo, Silverman and Nakayama, submitted to Science).

7. Filled versus Classical stereograms (Nakayama and Shimojo)

8. Role of stereoscopic depth in neon color spreading and transparency (Shimojo and Nakayama)

9. Parallel and serial search for visual feature conjunctions (Nakayama and Silverman)

10. Natural constraints and binocular rivalry (Shimojo and Nakayama)

11. Natural constraints and the perceived depth of unpaired binocular targets (Nakayama and Shimojo)

Participating Professionals:

Ken Nakayama
Shinsuke Shimojo
Manfred Mackeben
Gerald H. Silverman

Oral Presentations:

ARVO 1987 meeting	May 1987	
Badenweiler Conference	June 1987	Federal Republic of Germany
Neurosciences Atalier on Visual Motion,	July 1987	New York City

Ken Nakayama, Ph.D.
AFOSR-83-0320

Computational Neuroscience Course August 1987 Long island, NY
Computational Neuroscience Workshop August 1987 Woods Hole, MA
Vision: coding and efficiency Sept 1987 Cambridge, U.K.